

# USABILITY COST-BENEFIT MODELS

## *Different approaches to Usability Cost Analysis*

Mikko Rajanen

*Department of Information Processing Science, University of Oulu, PO Box 3000, FIN-90014, Oulu, Finland*  
*mikko.rajanen@oulu.fi*

Keywords: Usability, Usability Cost-Benefit Models, Cost of Usability.

Abstract: There are few development organizations that have integrated usability activities as an integral part of their product development projects. One reason for this might be that the costs and benefits of usability activities are not visible to the management. In this paper the author analyses some of the characteristics of the published usability cost-benefit analysis models. These models have different approach for identifying the costs of usability.

## 1 INTRODUCTION

Usability is defined as one of the main product quality attributes for the international standard ISO 9126. It means the capability of the product to be understood by, learned, used by and attractive to the user, when used under specified conditions (ISO 9126, 2001). Another usually referred to definition of usability is in standard ISO 9241-11, where usability is defined as: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 13407, 1999).

Usability has many potential benefits for a development organization such as increased productivity and customer satisfaction. But even today there are quite a few product development organizations reportedly having incorporated usability activities in their product development process. Bringing usability activities into the product development life cycle has been a challenge since the beginning of usability activities over fifty years ago (Ohnemus, 1996).

One reason for this is that the benefits of better usability are not easily identified or calculated. Usability engineering has been competing for resources against other project groups who do have objective cost-benefit data available for management review (Karat, 1994). The purpose of this paper is to categorise the usability cost-benefit analysis models based on their approach for the usability cost

analysis. This broad topic is approached through a following research question:

*How do the usability cost-benefit models approach and categorise the cost of better usability?*

The cost-benefit analysis is a method of analysing projects for investment purposes (Karat, 1994). It embodies the idea that decisions should be based on comparing the advantages and disadvantages of an action. Technical and financial data is gathered and analysed about a given business situation or function. This information assists in decision making about resource allocation.

The method has three steps and it proceeds as follows (Burrill and Ellsworth, 1980):

1. Identify the financial value of expected project cost and benefit variables.
2. Analyse the relationship between expected costs and benefits using simple or sophisticated selection techniques.
3. Make the investment decision.

Development management often sees usability activities as a potential risk to the deadline of their projects. It is difficult to implement usability activities in development projects without the support of the business management. Management level support for usability activities in development projects is achieved if the benefits of better usability can be identified and calculated. Better usability can for example speed up the products market introduction and acceptance (Conklin, 1991) and increase revenues (Wixon and Jones, 1991). In the usability cost-benefit analysis of usability activities,

expected costs (e.g., personnel costs) and benefits (e.g., lower training costs) are identified and quantified (Karat, 1994).

There are many published models for calculating usability benefits, and as many ways of identifying the benefits. A business benefit is a positive return that the development organisation expects to obtain as a result of an investment. There has been some discussion in publications about the potential business benefits of usability, but most of them are focused on case studies of usability benefits or the overall aspects of usability cost-benefit analysis. In this research, the author analysed the differences and characteristics between some of the published usability cost-benefit models.

Calculating the cost of better usability is fairly straightforward if the necessary usability tasks are identified (Mayhew and Mantei, 1994). The actual cost of usability can be divided into initial costs and sustaining costs (Ehrlich and Rohn).

## **2 OVERVIEW OF USABILITY COST-BENEFIT MODELS**

There are surprisingly few published models for analysing the benefits of usability in development organizations. Most of the existing usability benefit models analysed in this paper was selected from the book *Cost-Justifying Usability* by Bias and Mayhew. This book was published in 1994, but it is still the best source of different usability cost-benefit models. The analysed models taken from *Cost-Justifying Usability* were selected for this report because they represent the overall variety of different views for usability benefit analysis. The second edition of the book was published 2005 but it did not change the usability cost-benefit models (Bias and Mayhew 2005).

Bevan (Bevan, 2000) and Donahue (Donahue, 2001) have published two of the latest usability cost-benefit analysis models. These models were selected for this analysis because they have a slightly different point of view on different benefits of usability. The Bevan's model also estimates potential usability benefits in four different product life cycles while other analysed models do not have such a clear point of view about benefits in product life cycles.

### **2.1 Ehrlich and Rohn**

Ehrlich and Rohn analyse the potential benefits of better usability from the point of the view of the vendor company, corporate customer and end user (Ehrlich and Rohn, 1994). They state that by incorporating usability activities into a product development project, both the company itself and its customers gain benefits from within certain areas. When compared to the other usability benefit models analysed in this paper, Ehrlich and Rohn present the most comprehensive discussion about different aspects of usability cost-benefits.

According to Ehrlich and Rohn a vendor company can identify benefits from three areas:

1. Increased sales
2. Reduced support costs
3. Reduced development costs.

In some cases, a link between better usability and increased sales can be found, but usually it can be difficult to relate the impact of better usability directly to increased sales. One way to identify the impact of usability on sales is to analyse how important a role usability has in the buying decision.

The cost of product support can be surprisingly high if there is a usability problem in an important product feature, and the product has lots of users. Better usability has a direct impact on the need for product support and therefore, great savings can be realized through a reduced need for support. By focusing on better product usability and using usability techniques, a vendor company can cut development time and costs. The corporate customer can expect benefits when a more usable product reduces the time that end users need for training. And in addition to official training, there are also hidden costs for peer-support. End users often seek help from their expert colleagues, who therefore suffer in their productivity. It is estimated that this kind of hidden support cost for every PC is between \$6.000 and \$15.000 every year (Bulkeley, 1992).

End users are the final recipients of a more usable product. According to Ehrlich and Rohn, increased usability can result in higher productivity, reduced learning time and a greater work satisfaction for the end user. The end-user can benefit from higher productivity when the most frequent tasks take less time.

### **2.2 Bevan**

Bevan estimated the potential benefits of better usability for an organization to be during

development, sales, use and support (Bevan, 2000). A vendor can gain benefits in development, sales and support. A customer can benefit in use and support. When a system is developed for in-house use, the organization can identify benefits for development, use and support. In each category, there are a number of possible individual benefits where savings or increased revenue can be identified. The total amount of benefits from better usability can be calculated by adding all the identified individual benefits together. Bevan mainly discusses usability benefits derived from increased sales, a lower need for training and increased productivity. Benefits accruing due to decreased development time are identified but they are not discussed in detail.

### 2.3 Donahue

Donahue's usability cost-benefit analysis model (Donahue, 2001) is based on the model of Mayhew & Mantei (Mayhew and Mantei, 1994). In this model the costs and benefits of better usability are analysed through costs for development organisation and benefits for customer organisation. According to Donahue the most important aspect of usability cost-benefit analysis is calculating the savings in development costs.

### 2.4 Karat

Karat approaches usability benefits through a cost-benefit calculation of human factors at work (Karat, 1994). This viewpoint is different from other analysed usability benefit models. There are some examples of identified potential benefits. The benefits are identified as:

- Increased sales
- Increased user productivity
- Decreased personnel cost through smaller staff turnover.

A development organization can gain benefits when better usability gives a competitive edge and therefore increases product sales. A customer organization can gain benefits when end user productivity is increased through reduced task time and when better usability reduces staff turnover. Karat describes a usability cost-benefit analysis of three steps. In the first step, all expected costs and benefits are identified and quantified. In the second step, the costs and benefits are categorized as tangible and intangible. The intangible costs and benefits are not easily measured, so they are moved into a separate list. The third step is to determine a

financial value for all tangible costs and benefits. Karat also links the usability cost-benefit analysis with business cases. Business cases provide an objective and explicit basis for making organisational investment decisions (Karat, 1994).

### 2.3 Mayhew and Mantei

Mayhew and Mantei argue that a cost-benefit analysis of usability is best made by focusing attention on the benefits that are of the most interest to the audience for the analysis (Mayhew and Mantei, 1994). The relevant benefit categories for the target audience are then selected, and the benefits are estimated. Examples of relevant benefit categories are given for a vendor company and internal development organization. The vendor company can benefit from:

- Increased sales
- Decreased customer support
- Making fewer changes in a late design life cycle
- Reduced cost of providing training.

The benefits for an internal development organization can be estimated from the categories of increased user productivity, decreased user errors, decreased training costs, making fewer changes in a late design life cycle and decreased user support. To estimate each benefit, a unit of measurement is chosen for the benefit. Then an assumption is made concerning the magnitude of the benefit for each unit of measurement. The number of units is then multiplied by the estimated benefit per unit.

## 3 USABILITY COST FACTORS

The costs of better usability can be categorized into three groups: one-time costs, recurring costs and redesign costs. One-time costs or initial costs cover for example the costs of establishing a laboratory for usability testing. Recurring costs are for example the salary costs of the usability professionals employed in the usability testing laboratory. Redesign costs cover the costs of redesigning the prototypes for example based on the usability test results (Mayhew and Mantei, 1994).

### 3.1 One-Time Costs

Ehrlich & Rohn, Mayhew & Mantei and Donahue identify one-time costs and provide some example calculations of one-time costs of usability work. These models do not provide further documentation

about an overall cost calculation. Karat identifies the one-time costs but do not provide further documentation or example calculations (Karat, 1994). Bevan does not identify one-time costs of better usability at all (Bevan, 2000).

### 3.2 Recurring Costs

All of the analysed usability cost-benefit models identify the recurring costs of better usability as one factor in usability cost-benefit analysis. Ehrlich & Rohn and Mayhew & Mantei provide some example calculations and further discussion of recurring costs. These models do not provide further documentation about calculation of recurring usability costs. Karat, Bevan and Donahue identify the recurring costs of usability work but they do not provide example calculations or further discussion about cost calculation.

### 3.3 Redesign Costs

The costs of prototype redesign are different from other two usability cost factors that these costs usually affect a product development project directly. For example the product development project redesigns prototypes for the usability testing. Mayhew & Mantei identify the prototype related redesign costs and provide some example calculations about this cost factor but there is no further documentation about calculating the redesign costs. Karat identifies this cost factor but does not provide any example calculations or further discussion.

### 3.4 Comparing the Usability Cost-Benefit Models

There are some significant differences between the analysed usability cost-benefit models in identifying, documenting and providing example calculations for one-time costs, recurring costs and prototype redesign costs.

The comparison of the usability cost-benefit models and cost factors presented above is summarised in table 1.

Table 1. The extent of which the usability cost-benefit models identify and document the costs of usability.

Cost factors	One-time costs	Recurring costs	Redesign costs
Ehrlich & Rohn	XX	XX	O
Bevan	O	X	O
Donahue	XX	X	O
Karat	X	X	X
Mayhew & Mantei	XX	XX	XX

XX = The usability cost factor are identified and some example calculations are provided. No further documentation how to do the calculations.  
 X = The usability cost factor are identified but no example calculations or further documentation is provided.  
 O = The usability cost factor is not identified.

## 4 CONCLUSIONS

There are few development organizations that have integrated usability activities as an integral part of their product development projects. One reason for this might be that the costs and benefits of usability activities are not visible to the management. In this paper the author analysed how the published usability cost-benefit analysis models identify and document the usability cost factors.

None of the analysed usability cost-benefit models cover the one-time costs factor fully by identifying the cost, documenting the cost calculation and providing some example calculations. Ehrlich & Rohn, Donahue and Mayhew & Mantei cover the one-time costs factor best though they lack in either example calculations or documentation. Karat identifies the one time costs but does not provide either examples or further discussion. Bevan does not identify one-time costs at all.

None of the analysed usability cost-benefit models cover the recurring costs factor fully. Ehrlich & Rohn and Mayhew & Mantei cover the recurring costs best though they lack in either example calculations or further documentation. Bevan, Donahue and Karat identify the recurring costs factor but do not provide example calculations or further discussion.

None of the analysed usability cost-benefit models cover the prototype redesign costs factor fully. Mayhew and Mantei cover the redesign costs factor best but lack in documenting the redesign cost calculation. Karat identifies the prototype redesign costs factor but does not provide example calculations or further discussion about this cost factor.

## REFERENCES

- Bevan, N. *Cost Benefit Analysis version 1.1*. Trial Usability Maturity Process. Serco Usability Services.
- Bias, R., Mayhew, D. 2005. *Cost-Justifying Usability, Second Edition: An Update for the Internet Age*.
- Bulkeley, W. M., 1992. Study finds hidden costs of computing. *The Wall Street Journal*, Nov.
- Burrill, C., Ellsworth, L. 1980. *Modern Project Management: Foundations for Quality and Productivity*. Burrill-Ellsworth, New Jersey.
- Conklin, P. 1991. *Bringing Usability Effectively into Product Development*. In *Human Computer Interface Design: Success Cases, Emerging Methods, and Real-World Context*, Boulder, Co. July
- Donahue, G. 2001 *Usability and the Bottom Line*. IEEE Software.
- Ehrlich, K., Rohn, J. 1994. *Cost Justification of Usability Engineering: A Vendor's Perspective*. In Bias, R., Mayhew, D. *Cost-Justifying Usability*. Academic Press, pp 73-110.
- ISO 13407. 1999. *Human-centered design processes for interactive systems*. International standard.
- ISO/IEC 9126-1. 2001. *Software Engineering, Product quality, Part 1: Quality model*. International Standard.
- Karat, C-M. 1994. *A Business Case Approach to Usability Cost Justification*. In Bias, R., Mayhew, D. *Cost-Justifying Usability*. Academic Press, pp 45-70.
- Mayhew, D., Mantei, M. 1994. *A Basic Framework for Cost-Justifying Usability Engineering*. In Bias, R., Mayhew, D. *Cost-Justifying Usability*. Academic Press. 1994. pp 9-43.
- Ohnemus, K. 1996. *Incorporating Human Factors in the System Development Life Cycle : Marketing and Management Approaches*. IPCC96.
- Wixon, D., Jones, S. 1991. *Usability for fun and profit*. Internal report. Digital Equipment Corporation.